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Analysis of Industry's Perspective on the Digital Competencies of Vocational Human Resources

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ABSTRACT

Industry in the technological era, as an economic driver, is highly dependent on resource management, especially human resources. Vocational higher education graduates (Diploma 3 and 4/applied Bachelor's degrees) are designed to possess specific competencies aligned with labor market's demands. However, industries continue to report challenges in recruiting vocational graduates who fully meet their needs. This study employs the European Commission's Digital Competence Framework (DigComp) to evaluate the digital competencies of vocational graduates in Indonesia in relation to industry's expectations. A mixed-methods approach combined an online survey with in-depth interviews involving eight digitally oriented companies in Indonesia, proceeded by descriptive statistics and paired sample t-test. The statistic findings show insignificant difference ($p > 0.05$) between industry's expectations and graduates' competencies across DigComp's five dimensions: information and data literacy, communication and collaboration, content creation, security, and problem solving. Further findings reveal that graduates meet technical standards, but face recruitment barriers due to inadequacies in three essential soft skills, i.e., communication, negotiation, and presentation. These findings as a whole confirm the applicability of DigComp in the context of Indonesia's vocational education, while highlighting the needs to integrate generic competencies and strengthen structured industry collaboration to support long-term national digital workforce development.

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I. INTRODUCTION

The global trend of improving human resources to support their competitiveness by pursuing technological capabilities in the field of digital computing is an important part of sustainable economic development. The demographic bonus presents unprecedented opportunities and formidable challenges. As stated by the Statistics Indonesia's 2020 population census, of Indonesia's 270 million people, 48.85% are between the ages of 25 and 59 years old, and 16.65% are between the ages of 15 and 24 years old. This suggests that, if exerted strategically, this youthful population could propel national economic growth. Historical precedents from East Asian economies illustrate that during periods of rapid demographic transition and growth in working-age population, GDP expansion often exceeded 7–8% per year (e.g., 8.2 and 7.3% in Singapore and Korea's cases, respectively), driven significantly by the first demographic dividend from a productive workforce (Mason & Kinugasa, 2008). On the other hand, Indonesia, with its per capita income stagnating below high-income threshold, risks being trapped within middle-income economies by 2030, (Larson et al., 2016). The 2020 National Labor Force Survey (Sakernas) underscores this vulnerability, reporting an unemployment rate of 15–19% among young people aged 15–19 years old, compounded by low labor productivity and skills mismatches within the Fourth Industrial Revolution (Industry 4.0) landscape (Schwab, 2016).

Moreover, Indonesia is at risk of economic stagnation, as evidenced by simple and panel regression analysis of Sakernas data from 2015 to 2020 (Al Ayyubi et al., 2023). This gap is particularly pronounced in several key sectors, such as manufacturing, healthcare, IT, and services, where digital fluency, such as information literacy, collaboration, content creation, security, and problem solving, determines employability and productivity. However, challenges remain (Astuti et al., 2022), such as the rural-urban gap in infrastructure access, uneven curriculum relevance, and inadequate industry-academia relations, all of which hinder the absorption of human resources into the formal and informal labor markets. As industries shift toward automation, AI, and data-driven processes, the demand for digitally competent human resources has surged, with projections estimating 9 million unfilled digital jobs by 2025 (Das et al., 2016). This need has been intensified by the emergence of digital technology accelerated by the COVID-19 pandemic. Within this landscape, vocational education has emerged as a strategic instrument, tasked with fostering competencies that combine technical proficiency (hard skills) with adaptive and interpersonal attributes (soft skills), even though it also must evolve beyond traditional training system to foster resilience against technological disruption.

Prior studies on digital competencies in vocational education in developing countries, such as Indonesia, highlighted various barriers and enablers (Astuti et al., 2023; Mulyanti et al., 2024; Gayatri et al., 2023; Rahmawati et al., 2025; Harjanti et al., 2023). A pertinent guide, namely the 2022 European Commission's Digital Competence Framework for Citizens (DigComp) 2.2 (Vuorikari et al., 2022) serves as a baseline benchmark describing five competence domains (information and data literacy, communication and collaboration, content creation, security, and problem solving) across eight proficiency levels to guide citizen and workforce development. The framework adaptations in the context of Asian countries, such as Vietnam (Nguyen et al., 2024), show that individual factors, such as age, education, and self-efficacy, significantly predict competency levels, revealing urban-rural gaps (Xu et al., 2025) similar to those of Indonesia. Empirical study in the context of Indonesia (Mulyanti et al., 2024) confirmed moderate digital literacy among vocational high education students, influenced by attitudes, support systems, and infrastructure, but rural access gaps remain, as validated by scale development in vocational institutions (Nguyen et al., 2024; Xu et al., 2025).

Barboutidis and Stiakakis (2023) argued that the competence of educators, such as teachers and lecturers, remains a critical challenge in many vocational education systems, with varying levels of competence depending on institutional profiles and the availability of organizational supports. In the context of Technical and Vocational Education and Training (TVET) in Indonesia, prior studies showed that educators generally demonstrate low to moderate levels of digital competencies, a condition that became more apparent during the COVID-19 pandemic due to limited availability of devices and internet connectivity (Mulyanti et al., 2024). The development of these competencies are shaped by several determinants, such as gender, professional experience, and participation in training programs, with empirical evidence from vocational institutions showing that continuous professional development is positively associated with increased digital teaching competencies. In addition to factors related to educators, the institutional environment also plays a crucial role

in shaping the development of students' digital competencies in vocational institutions, where institutional supports and peer collaboration have been identified as key enabling factors.

Further structural equation modeling analysis confirms that these factors significantly contribute to the development of specific competency domains, particularly digital security and problem solving skills. Ultimately, the effectiveness of vocational education in strengthening digital competencies is closely related to labor market outcomes, as higher levels of vocational education, such as Diploma 4 (applied Bachelor's degree) program, have been shown to significantly increase the likelihood of decent employment and steady income compared to those of lower diploma levels, reinforcing argument in discourse on human capital that additional educational investment increases labor market returns (Fachrizal et al., 2025).

Nonetheless, several aspects from industry's perspective remain under-explored, highlighting employability gaps. A study on Merdeka Belajar Kampus Merdeka (MBKM) internships (Santioso, 2024) revealed discrepancies between graduates' digital skills and industry's demands, projecting a 2021–2025 labor shortage within Indonesia's digital economy (Gayatri et al., 2023). Emerging study on the impact of AI in laboratory-based vocational learning emphasizes the need for improved skills in content creation and ethical security, aligning with the DigComp proficiency scale (Zervas & Stiakakis, 2025). The integration of 21st-century skills into the existing vocational curriculum, including the implementation of digital portfolios for teachers, shows promise as well as underscores ongoing challenges in connectivity and pedagogical adaptation (Pratiwi et al., 2025; Herlinawati et al., 2024; Judijanto and Nurwanto, 2024). A broader snapshot of Indonesia's vocational education criticizes the preparation of adaptive human resources for the 21st century (Judijanto and Nurwanto, 2024)) and advocates for systematic on-the-job training to bridge the supply-demand imbalance.

These prior studies collectively highlight systemic issues of low productivity, skill mismatches, and infrastructure deficits, reflecting gaps in technological adoption among vocational students and graduates (Kholifah et al., 2025). However, a gap remains in direct industrial input to align vocational graduates' competencies with DigComp's five core dimensions, particularly within multisectoral and regional settings (Rahmawati et al., 2025). This study, therefore, distinguishes itself by shifting from educator- and student-centered analysis toward empirical industry's perceptions, utilizing a survey involving eight diverse companies (89% digitally oriented) in Java, Sumatra, and Kalimantan. This study also tracks real-world absorption, integrating mixed methods with DigComp adaptations to generate specific insights in the context of Indonesia. By addressing regional variance and soft-skill variability, this study fills a critical gap in bridging vocational higher education outcomes with the demands within Industry 4.0 landscape, offering a transferable model for developing economies.

Based on the aforesaid background, this study draws upon DigComp's five core dimensions to addresses the following research questions: (1) Are there differences in the expected and actual digital competencies among vocational graduates from industry's perspective? (2) Are there differences in the expected and actual competencies of Information and Data Literacy (IDL) among vocational graduates from industry's perspective? (3) Are there differences in the expected and actual competencies of Collaboration Communication (CC) among vocational graduates from industry's perspective? (4) Are there differences in the expected and actual competencies of Digital Content Creation (DCC) among vocational graduates from industry's perspective? (5) Are there differences in the expected and actual competencies of Safety (S) among vocational graduates from industry's perspective? (6) Are there differences in the expected and actual competencies of Problem Solving (PS) among vocational graduates from industry's perspective?

This study, therefore, aims to (1) describe the digital competencies required by industry based on DigComp's five dimensions; (2) evaluate the differences between the expected and actual competencies among vocational higher education graduates from industry's perspective; and (3) assess the effectiveness of vocational higher education in promoting digital adoption in the workplace. This study would yield several benefits: improving the picture of the actual work capabilities of vocational human resources in industry, informing whether it is necessary to revise the National Medium-Term Development Plan (RPJMN) to achieve 19 million digital job vacancies by 2025, and increasing inclusive growth by improving digital competencies aligned with DigComp. Furthermore, this study would contribute to Golden Indonesia 2045 Vision (Visi

Indonesia Emas 2045) by strengthening human resource resilience in technology sector.

II. LITERATURE REVIEW

A. DigComp and Its Evolution

The European Commission's Digital Competence Framework for Citizens (DigComp) was introduced in 2013 and has undergone continuous development, with DigComp 2.2 being the latest version (Ferrari, 2013; Matter et al., 2022, Vuorikari et al., 2022). DigComp defines digital competence as "the confident, critical, and responsible use of digital technologies for learning, working, and participating in society" (Vuorikari et al., 2022). The framework is built upon five interrelated competence domains: (1) information and data literacy [IDL] (searching, evaluating, and managing data and information); (2) communication and collaboration [CC] (interacting, sharing, and collaborating through digital technologies); (3) digital content creation [DCC] (creating, integrating, and protecting intellectual property); (4) safety [S] (protecting devices, personal data, privacy, and well-being); and (5) problem solving [PS] (solving technical problems and creative use of digital tools)

Each domain is measured across eight proficiency levels (from foundation to highly specialized) (Zhao et al., 2021). DigComp adopts a holistic and developmental approach, aligning with the UNESCO's TVET guidelines that emphasize lifelong learning and practical competency development (Zhong & Juwaheer, 2024). Theoretically, DigComp is often discussed in conjunction with two pertinent frameworks, i.e., Technology Acceptance Model (TAM) and Technological Pedagogical Content Knowledge (TPACK), as it bridges digital skills with technological adoption behavior and pedagogical application in vocational education.

B. Global and Asian Implementation of DigComp

DigComp has been widely adapted worldwide in Vocational Education and Training (VET). In Europe, integration of AI and IoT modules based on DigComp increased students' problem solving skills by 25–30% in pilot programs (Zervas & Stiakakis, 2025). In Asia, several countries have adapted the framework to address urban-rural digital divide and industry's demands. A sequential mixed-methods study in Vietnam found that demographic factors (age and education) explained 28% of the variance in digital competency levels, with younger urban respondents showing significantly higher skills in digital content creation than those of rural counterparts (Nguyen et al., 2024). In Central Asia, DigComp-based workshops improved VET instructors' safety awareness by 40%, although infrastructure limitations remain a major barrier of scalability (Nguyen et al., 2024; Zhong & Juwaheer, 2024). In Hong Kong, the DigComp adoption in TVET resulted in a 15% increase in students' collaboration skills through blended learning (Zhong & Juwaheer, 2024; Wu et al., 2025).

Table 1. *Dimension of DigComp*

Dimension	Previous Studies	Identified Skill Gaps
Information and Data Literacy (IDL)	Vietnam: High urban evaluation skills (Nguyen et. al., 2024; Elstad, 2016; Eshet, 2002; Eshet-Alkalai, 2012)	Infrastructure barriers (limited internet connectivity and device access in rural regions)
Communication & Collaboration (CC)	Hong Kong: Mixed tools enhance interaction (Zhong & Juwaheer, 2024	Variability in English proficiency
Content Creation (DCC)	India/Thailand: AI integration aids programming (Zervas & Stiakakis, 2025)	Low copyright awareness and intellectual property
Security (S)	Central Asia: Workshops improve privacy (European Training Foundation, 2022)	Underestimation of cyber risk and data protection
Problem Solving (PS)	Meta-analysis: Support mediates creativity (Cattaneo et al., 2022)	Lack of institutional supports for innovative use of technology

C. Digital Competencies in the Context of Indonesia

In Indonesia, TVET is expanding rapidly to tackle youth unemployment (15–19%) and meet the projected need of 19 million digital workers by 2025 (Sakernas, 2020). Studies show that Indonesia's vocational teachers and students possess high awareness of digital citizenship, even though practical proficiency remains limited. Only 62% of respondents demonstrated moderate proficiency in the safety domain due to the sudden shift toward online learning during the COVID-19 pandemic (Astuti et al., 2023).

Teachers' competencies in TVET are moderate and strongly influenced by years of experience and training (Nguyen et al., 2024; Astuti et al., 2023). Quantitative studies indicate that self-efficacy and

institutional supports are significant predictors of digital literacy among vocational students, consistent with European benchmarks, even though rural-urban disparities persist (Zhong & Juwaheer, 2024).

From industry's perspective, a study on MBKM internships found that 78% of students' digital competencies were relevant to industry's demands (Santioso, 2024). However, graduates still lack soft skills (e.g., negotiation) and advanced competencies in emerging technologies, such as AI. Likewise, Zervas and Stiakakis (2025) reported that vocational graduates are 20–37% more likely to adopt recent technologies in the workplace, even though industry demands stronger integration of digital skills in laboratory and work-based learning.

D. Research Gap and Theoretical Contribution

Although DigComp has been widely studied in Europe and parts of Asia, study on its alignment with industry's demands in Indonesia remains scarce, particularly regarding company-level perceptions. This study, therefore, aims to fill this gap by examining DigComp alignment from multiple perspectives (teachers, students, and industry). Theoretically, this study would contribute by integrating DigComp with the Human Resource Development (HRD) model and technological adoption theories, proposing a hybrid framework that combines DigComp with local Sustainable Development Goals (SDGs) and Indonesia's vocational education characteristics.

III. METHODOLOGY

This study employs a mixed-methods research design: a quantitative approach in the form of an online survey using the Kobotoolbox application was combined with a qualitative approach in the form of semi-structured in-depth interviews, both involving representatives of eight companies selected (whose names were mentioned as A, B, C, D, E, F, G, and H to maintain confidentiality). Through these approaches, various challenges related to the digital competencies of vocational human resources were identified and explored in greater depth.

The survey data were used to measure industry's perceptions regarding the digital competencies of vocational graduates in Indonesia who are both prospective employees and actual employees. The quantitative data were analyzed using descriptive statistical techniques. The questionnaire was adapted from the DigComp framework developed by Ferrari (2013), which assesses digital skills and technological mastery across five competence domains. This framework was selected owing to its strong policy relevance, cross-national comparability, and proven capability to provide a comprehensive assessment of digital competencies (Ferrari, 2013; European Commission, 2013).

An online survey was employed to facilitate companies' representatives as respondents in responding and filling out the questionnaire accurately and quickly, also to make it easily accessible. The results were then open-coded and categorized to be described, interpreted, and explained. Neuman (2014) and Creswell (2014) stated that mixed-methods approach is a good instrument, since it combines quantitative and qualitative data to obtain saturation points and therefore helps researchers in explaining the phenomena examined.

The population of industry stakeholders in digitally affected sectors is spread across Indonesia. A purposive sampling strategy, therefore, was used to ensure diversity in scale, type, and geography of companies, resulting in eight companies: seven private/national-scale companies and one state-owned company, covering manufacturing, finance, robotics, and creative sectors. They were selected based on collaboration and relevance to vocational outcomes, representing digitally-related operations, even though there are non-digital entities that universally require digital skills.

The questionnaire's targeted respondents included industries that are spread across several provinces in Indonesia: North Sumatra, Riau Islands, DKI Jakarta, DI Yogyakarta, East Java, and Central Kalimantan. This study was conducted in 2024 over a period of one year. The survey results in the form of quantitative data were then analyzed statistically using descriptive difference tests due to the limited number of samples, which were less than 30 respondents. Descriptive difference tests were conducted using JASP, since it is an easy-to-use statistical application with a free license. Finally, qualitative data from interviews were integrated with quantitative data to interpret the results in order to answer the research questions.

IV. RESULTS

As a field of work for vocational higher education graduates, industry has established various criteria comprising basic competencies for prospective employees of relevant companies. Based on the findings of online survey and in-depth interviews with eight companies, it was found that digital competencies were adopted from European

DigComp (Ferrari, 2013). DigCom, with its five dimensions, is highly needed and has become a criterion of digital competencies. The five core competencies—information and data literacy, communication and collaboration, digital content creation, safety, and problem solving—are related to aspects of knowledge and capabilities in utilizing digital technology. These five dimensions fall under the core competencies that must be possessed and mastered by vocational higher education graduates so that they are well-equipped to enter the workforce. In reality, the world of work or industry itself, in addition to requiring high-quality human resources with satisfactory digital skills, also always sets high competency criteria aligned with global trend to secure excellent human resources. This suggests that vocational human resources possessing only basic competencies without digital skills would be more likely to face recruitment barriers, while the ones possessing additional and valuable competencies, such as updated digital skills, would be more likely to find better work and career opportunities.

Concerning industry's demands for digital competencies among vocational graduates, following is the eight companies' detailed profile:

Table 2. *Profile of Eight Companies Examined*

Variable	Category	Count	Total
Province	DI Yogyakarta	2	8
	DKI Jakarta	1	8
	East Java	1	8
	Central Kalimantan	1	8
	Riau Island	2	8
	North Sumatra	1	8
Type of Company	State-owned/regional-owned	1	8
	Private	7	8
Level/Size of Company	International/ multinational	1	8
	National/legal entity entrepreneur	7	8
The Relevance of D-III/D-IV Vocational Education to Employment	Several are relevant (40–80%)	2	8
	Only few are relevant (< 40%)	1	8
	Very relevant (81–100%)	5	8
Alignment of Vocational Education with Job Levels	One level lower	1	8
	One level higher	1	8
	Same level	6	8
Relevance of Business Fields to Digital Competencies	No	1	8
	Yes	7	8

Source: Data processed (2026)

Table 2 shows that the companies examined operate in various fields, both multinational and regional, including state-owned enterprises and private companies. These eight companies are spread across Sumatra, Kalimantan, and Java. In addition, 87.5% of them are engaged in digital technology sector, while 12.5% are not technology-based. However, all of them require digital skills in their business processes, since it is necessary for today's employees to master digital competencies to improve companies' performance (Van Deursen & van Dijk, 2009).

These eight companies have varying perceptions and assessments regarding digital competencies among higher education graduates, with vocational graduates being considered superior in their fields. As seen from Table 2, of all employees who are vocational graduates, 12.5% have a relevance of 40–80% to their field of work, 25% have a relevance of < 40% to their field of work, and 62.5% have a relevance of 80–100% to their field of work. Moreover, of all employees who are vocational graduates, 75% work at job whose level is the same as that of their education, 12.5% work at job whose level is higher than that of their education, and 12.5% work at job whose level is lower than that of their education.

As seen in the assessment findings on the needs for digital competencies and the reality of vocational human resources already employed in the workplace, the majority of the data indicate that vocational graduates in general possess satisfactory digital competencies. DigComp consists of five dimensions, namely information and data literacy, communication and collaboration, digital content creation, safety, and problem solving, all of which refer to aspects of knowledge, attitude, skills, and examples of the objectives of their implementation (Ferrari, 2013, Vukčević et al., 2021).

Industry's Perspective on Digital Competencies among Vocational Human Resources

This study's research data are limited to a sample size of eight companies so that the analysis employs descriptive difference tests by looking at the comparison of mean values from DigComp's dimensions. The competencies were compared using paired sample t-test to see the differences in

digital competencies between prospective employees and actual employees, which were assessed based on industry's perception of the digital competencies among vocational graduates. Based on Table 3, there are no significant differences in all dimensions of digital competencies between prospective employees and actual employees, since all resulting p-values exceed 0.05.

Table 3. *Paired Sample T-Test Results of Industry's Expectations on Digital Competencies among Vocational Graduates Who are Prospective Employees and Actual Employees*

Expectations	Reality	t	df	p	Cohen's d	SE Cohen's d
DIGCOMP	DIGCOMP2	1.120	7	.300	0.473	0.445
IDL	IDL 2	1.718	7	.130	0.721	0.471
CC	CC 2	1.209	7	.266	0.435	0.376
DCC	DCC 2	0.089	7	.932	0.035	0.391
S	S 2	1.166	7	.282	0.371	0.329
PS	PS 2	1.174	7	.279	0.600	0.555

Note: Cohen's d corrected for correlation between observations.
Source: Data processed (2026)

The results showed in Table 3 indicate that the eight companies perceive vocational human resources as possessing relatively consistent expected and actual competencies across all DigComp's dimensions (IDL, CC, DCC, S, and PS), as evidenced by the non-significant paired sample t-test results ($p > 0.05$). Furthermore, the paired sample t-test analysis across all DigComp's dimensions also reveals statistically insignificant differences, with all p-values exceeding 0.05. These findings suggest that industry's expectations regarding the digital competencies of vocational graduates who are prospective employees generally align with the actual competencies demonstrated by the ones currently employed in the workplace.

Likewise, as seen from the comparison of the mean values of DigComp's dimensions between the expected digital competencies and the actual competencies among vocational human resources, there is also no significant difference between both. From all comparisons using the difference test, a p-value exceeding 0.05 was obtained, indicating that according to the eight companies, there is no significant difference between the expected digital competencies and the actual competencies among vocational graduates currently employed in the workplace.

Based on industry's perspective and as a description of the field phenomenon resulted from in-depth interviews, various obstacles related to vocational human resources based on DigComp's five dimensions were identified. The industry feels that they frequently face obstacles in collaborating with vocational higher education institutions as providers of vocational human resources. The obstacles comprise (1) the lack of quality vocational human resources who meet industry's specific human resource criteria, (2) the shortage of quality vocational facilities and infrastructures that align with industry's demands, (3) the lack of core competencies among several vocational students and graduates that meet industry's demands, and (4) the difficulty to find prospective employees who are deemed suitable for relevant field of work.

"We have long collaborated with vocational higher education institutions, such as polytechnics and vocational schools in Indonesia and have provided facilities and infrastructure for training and internships for vocational students in the form of campus internships or independent internships, ... however, they still do not possess several soft skills that supposedly support their hard skills." (A, B, C, D, E, F, G, H)

"In practice, vocational students have mastered a variety of digital technology skills and are ready to work, but they still lack resilience and the ability to work under pressure. In addition, they still lack the specific skills required by industry, especially those related to competency certification." (A, B, C, D, E, F, G, H)

Furthermore, during the recruitment process held by industry, vocational graduates often faces several obstacles that cause them to be deemed unsuitable for recruitment. In reality, according to the industry, many prospective employees experience difficulties at the job interview stage because they are unable to communicate their abilities.

"During the selection process, many candidates fail the at the psychological test and interview stages because they are unable to provide a specific description of the skills we require." (A, C, D, F, G)

"Their gestures during the interview stage, which do not adequately demonstrate their abilities, also become an obstacle because that is how we assess

candidates' suitability. Even if their digital technology skills are okay... if their teamwork and communication skills are not good, that will also be noted..." (A, C, D, F, G)

According to the industry's assessment, many candidates still possess inadequate communication skills to convey their ideas and concepts and are still unable to properly demonstrate their skills and work experiences to the interviewers. Ultimately, due to these weaknesses, they are unable to strategically negotiate and discuss with the interviewers. This often causes them to fail at the job interview stage during the recruitment process.

Various efforts have been made by the industry to improve the competencies of vocational graduates to meet the required competency criteria.

"We do not remain silent about our human resources, including the ones at the vocational level, because we have a human resource development strategy with a rotation system during the early years to explore their potentials, not only in digital technology skills, but also in other soft skills, especially the ability to manage work, leadership, collaborate in teams, and communication skills." (A, B, F, G)

"We provide continuous training for our human resources and support them in developing their potentials and competencies, including our students who are conducting internship with us.." (A, B, C, D, H)

"We have collaborated with schools and universities, such as polytechnics, to provide internships for students here... if they possess relevant potentials, they can start working immediately, especially the ones possessing technological skills and abilities we need..." (A, B, C, D, E, F, G)

Regarding the aforesaid remarks, the facilitations provided by the industry comprise necessary training in the relevant field of work, opportunities and supporting workshops at the internship level with seniors or colleagues, coaching, and opportunities for employees to learn independently through projects or case studies. The industry also sees and has a need for competencies in certain fields, especially digital technology, which is legalized via standardized competency certification. These measures aim to improve the competencies of vocational human resources, both as prospective employees and actual employees, as well as to support the performance of companies employing them.

According to industry's perspective on vocational human resources, there is no significant difference between the expected and actual digital competencies of vocational human resources across all DigComp's dimensions. This indicates that vocational graduates generally possess digital competencies that align with industry's expectations and qualification standards. The industry perceives that vocational human resources demonstrate adequate abilities in IDL, CC, DCC, S, and PS regarding the utilization of digital technology, consistent with the competencies expected in the workplace.

These findings suggest that vocational higher education institutions have been relatively successful in equiping their graduates with digital competencies that meet industry's demands. Furthermore, this study indicates that vocational higher education institutions that emphasize the development of digital competencies would contribute positively to technology utilization in the workplace, employment opportunities, labor productivity, and overall industrial performance.

V. DISCUSSION

A. Alignment of Vocational Graduates' Digital Competencies with Industry's Expectations

This study's findings indicate that there is no significant difference between the digital competencies expected by industry and the actual competencies among vocational higher education graduates across all DigComp's dimensions, thereby carrying important implications for vocational education policy and practices. This alignment suggests that the current VET curriculum in Indonesia, at least in terms of technical digital skills, has successfully responded to industry's demands. It also validates DigComp as a reliable measurement instrument in the context of developing countries, supporting its broader applicability beyond European settings where it originated.

This finding resonates with regional adaptation efforts documented in Vietnam and Thailand, where localized versions of DigComp, in similar ways, has helped in bridging curriculum-industry gaps (Nguyen et al., 2024; Pratiwi et al., 2025; Astuti et al., 2022). However, the absence of significant gaps in technical skills should not be interpreted that vocational graduates are fully ready to enter the workplace. As the findings reveal, three non-technical competencies, i.e., communication, negotiation, and presentation, remain underdeveloped relative to recruitment expectations (Hapsari et al., 2024). Whereas, these soft skills frequently serve as decisive factors in

hiring decisions, meaning that mere technical competencies are insufficient for graduate employability.

B. Structural Barriers in Industry-Education Collaboration

Despite the technical alignment identified, the qualitative findings reveal a fundamental weakness in how industry and vocational higher education institutions engage with one another. Existing partnerships remain transactional, since both parties delimit themselves to internship placements and ceremonial MoU signings without commitment to substantive curriculum co-development or work-based learning integration. This finding aligns with Cedefop's (2022, 2024) emphasis on structured, curriculum-embedded work-based learning as an essential driver of market-relevant graduate outcomes (Audretsch & Link, 2017).

In this sense, the vocational teaching workforce actually poses a critical bottleneck. Many vocational instructors possess only intermediate digital competencies and lack the pedagogical capacities to effectively integrate emerging technologies into their teaching system (Suryadi et al., 2024; Vukčević et al., 2021). This drawback creates a cascading effect: without digitally proficient instructors, curriculum updates cannot be operationalized in classrooms regardless of how well-designed they are on paper. Thus, vocational teaching staffs should pursue continuous professional development not as an ancillary concern, but as a prerequisite to sustainably improve graduates' quality.

C. Policy Implications and Strategic Integration

From policy standpoint, the findings support the Indonesian government's RPJMN target of generating 19 million digital jobs by 2025. The integration of DigComp into the national VET curriculum offers a standardized mechanism to systematically develop workforces' digital readiness. Moreover, standardization also carries additional strategic value; as noted by Janssen et al. (2020), competency frameworks that enable cross-country comparison would facilitate skill transferability, a critical asset given ASEAN labor mobility agreement and the increasingly integrated regional economy.

D. Toward an Integrated and Contextualized Model

Moving forward, vocational higher education must evolve beyond technical skill delivery toward a sustainable model that simultaneously integrates technical, pedagogical, and industrial competencies (Harjanti et al., 2023; Fallon, 2020). This study revals that industry struggles to align with vocational higher education institutions on both the quality and quantity of vocational human resources, underscoring the needs for deeper structural reform rather than surface-level collaboration.

Furthermore, any nationwide implementation of DigComp must accommodate local variations in infrastructure access, regional economic structures, and multisectoral industry's demands. This implies that the implementation's success in practice is determined by strategic cultural and contextual adaptation (Vukčević et al., 2021). Finally, given the rapid evolution of today's technologies, such as AI, automation, and data analytics, longitudinal studies spanning multiple sectors and regions are essential to track shifting industry's requirements and ensure that VET's responsiveness within this landscape remains dynamic rather than static.

VI. CONCLUSION

Based on the five dimensions of DigComp 2.2 framework, the industry perceives that there is no significant difference between the expected digital competencies and the actual competencies among vocational higher education graduates in Indonesia. These findings indicate that the current vocational curriculum is sufficiently relevant in preparing graduates to enter the digital workforce. This is at least confirmed in terms of technical digital skills. However, the main challenges arise in three essential soft skills, i.e., communication, negotiation, and presentation, all of which directly affect the graduates' success during the recruitment process. In addition, collaboration between industry and educational institutions is still formal in nature and has not reached the level of curricular integration that could improve the quality and generic skills of vocational graduates.

Future studies should conduct longitudinal approaches that monitor the development of vocational graduates' digital competencies over a certain period of time and compare the effectiveness of industry-based learning models in various regions of Indonesia. Furthermore, in-depth qualitative studies are needed to explore the perspectives of lecturers, students, and industries regarding the determinants and obstacles of DigComp contextual implementation. The integration of a mixed-methods approach would also provide a more comprehensive understanding of how digital competencies could be developed sustainably to support the Golden Indonesia 2045 Vision *(Visi Indonesia Emas 2045)*.

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